Appl. No. 10/602,556
Amdt. dated October 24, 2005
Reply to Office Action of June 3, 2005

PATENT

REMARKS/ARGUMENTS

Claims 21-40 were pending in this application and examined. Claims 21-40 remain pending in this application after entry of this amendment.

THE CLAIMS

Claims 21-40 are rejected under 35 U.S.C. 102 (b) as being anticipated by Sclaroff et al. (USO-5,590,261) (hereinafter "Sclaroff"). Applicant submits that the claims are patentable for at least the reasons described below.

Claim 21

As recited in claim 21, a computer-implemented method is provided for generating a graphical warp through transformation of an undeformed model to a deformed model. The method includes separate steps of receiving information specifying an undeformed model and a set of feature specifications, each feature specification comprising a source feature and a target feature. Further, a set of transformations is received for mapping the source feature to the target feature in each feature specification. Further, a set of strength fields is received for scaling the magnitude of transformations in the set of transformations to generate a set of scaled transformations. A set of weighting fields defined over the undeformed model is received for determining the relative influence of the set of scaled transformations. The deformed model is then generated by applying the set of transformations, the set of strength fields, and the set of weight fields to the undeformed model.

The method recited in claim 21 provides a generalized flexible solution for generating warps. As recited in claim 21, the set of feature specifications and the set of transformations may be independently received. Further, the set of strength fields and the set of weighting fields are decoupled and may be separately received. This provides a warp designer the flexibility to modulate and blend transformations of a model. By allowing the set of feature specifications, the set of transformations, the set of strength fields, and the set of weighting fields to be received in the manner recited in claim 21, an infinite number of deformations may be used

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on any undeformed model. This provides a generalized and flexible method for performing any number of deformations. Applicant submits that these features are not taught or suggested by Sclaroff.

Sclaroff is directed to the feature-correspondence problem encountered in object recognition, alignment, and morphing (Sclaroff: col. 1 lines 7-9). Correspondence determination is a prerequisite of morphing (Sclaroff: col. 2 lines 1-2). As described in the Background section of Sclaroff, given a source image and a target image, correspondences must be assigned between feature points in the source image and those in the target image. However, to do this without human intervention is a problem. (Sclaroff: col. 1 lines 36-45). The invention described in Sclaroff describes a correspondence-assignment technique that considerably reduces the degree to which humans must intervene in morphing, alignment, and object recognition. (Sclaroff: col. 2 lines 6-8).

In Sclaroff, modal displacements are used to find correspondences between features points in the source and target images (Sclaroff: col. 2 lines 26-28). The behavior of each node in an image under various modes of the body's (deformational) motion is computed, and the correspondence for a given node is determined on the basis of how similar its behavior is to that of its candidate mate in the other image (Sclaroff: col. 2 lines 34-39). The extracted feature points or nodes are characterized in terms of their participation in the motion of various modes of (often deformational) motion of an elastic sheet in which they are assumed to be embedded. To identify these modes of motion, an equation of motion is determined for the system of nodes for the source image and for the target image. The equation of motion describes the variations in the displacements of the various nodes from their rest positions as the elastic sheet vibrates or otherwise moves. (Sclaroff: col. 4 lines 49-58).

In Sclaroff, the equation of motion is determined based upon the elastic sheet's vibration, elastic restorative forces experienced by the nodes, inertial forces at each node in relation to the acceleration at the nodes, stresses throughout the elastic sheet, and stiffness factor. As depicted in Fig. 1 of Sclaroff and the associated description, the equation of motion is determined for nodes in the source image and in the target image. Associations between features in the source image and features in the target image are then determined based upon the

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equations as determined by how close they are in the generalized feature space (Sclaroff: col. 10 lines 12-15). Correspondence between the nodes in the source image and target image is determined by determining how close the generalized feature vector determined for a feature (i.e., nodal) point in one image is to that determined for a feature point in the other image (Sclaroff: col. 10 lines 45-48).

Applicant would like to point out that the equations of motion and the processing depicted in Fig. 1 of Sclaroff is substantially different from claim 21. Claim 21 recites a method for warping an undeformed model to produce a deformed model using a set of transformations, set of strength fields, and set of weighting fields. Fig. 1 of Sclaroff and the associated description has nothing to do with warping as recited in claim 21 -- instead, the processing in Sclaroff is used to determine correspondences between a source image and a target image. For example, as described in Sclaroff col. 10 line 66 - col. 11 line 10 and col. 12 lines 3-10, for a source point i to be considered to correspond to a target point j, the conditions described in col. 12 lines 5-7 have to be met. This produces a number of correspondence pairs, also called pairs of "anchor" points. Sclaroff further describes that the identified anchor pairs can then be used to determine the function for mapping other points from the source image to the target image. The mapping function may be applied to identify the feature points in the target image that correspond to points in the source image (Sclaroff: col. 22 lines 39-43).

Accordingly, Sclaroff merely describes a mechanism for associating source features with target features. This is not the focus of the invention recited in claim 1. The invention in claim 1 is concerned with the larger question of how to warp the undeformed model to the deformed model in light of corresponding source and target features.

Sclaroff further discusses morphing operations, which involve the generation of intermediate images that, shown in succession, make an object in the source image appear to metamorphose into an object in the target image. In Sclaroff, this is accomplished by image-to-image interpolation. (Sclaroff: col. 20 lines 4-13). Examples are shown in Fig. 6 and Fig. 7 of Sclaroff and described in cols. 20 and 21. These examples use flow fields to generate the intermediate images. These examples use animation functions to determine intermediate frames.

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However, Applicant submits that the processing performed for the examples depicted in Figs. 6 and 7 of Sclaroff is substantially different from the warping method recited in claim 21. Unlike Sclaroff, the method of claim 21 is not concerned about determining intermediate images between a given source image and a target image. Claim 21 recites a method for warping an undeformed model to produce a deformed model using a set of transformations, set of strength fields, and set of weighting fields. The set of strength fields and the set of weighting fields are decoupled and separately received. This provides a warp designer the flexibility to modulate and blend transformations of a model. By allowing the set of feature specifications, the set of transformations, the set of strength fields, and the set of weighting fields to be received in the manner recited in claim 21, an infinite number of deformations may be used on any undeformed model. This provides a generalized and flexible method for performing any number of deformations. Applicant submits that these features are not taught or suggested by Sclaroff.

In light of the above, Applicant submits that claim 21 is patentable over Sclaroff for at least the reasons stated above.

Claims 22-29

Applicant submits that claims 22-29 that depend from claim 21 should be allowed for at least a similar rationale as discussed for allowing claim 21, and others. The dependent claims also recite additional features that make the claims patentable for additional reasons.

Claims 30-40

Applicant submits that independent claims 30, 32, 34, 37, 39, and 40 should be allowable for at least a similar rationale as discussed for allowing claim 21, and others.

Applicant submits that dependent claims 31, 33, 35-36, and 38 that depend from independent claims 30, 32, 34, and 37 respectively, should be allowed for at least a similar rationale as discussed for allowing the independent claims, and others. The dependent claims also recite additional features that make the claims patentable for additional reasons.

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CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,

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